SECTION 300

300. SIGNING, PAVEMENT MARKINGS, TRAFFIC SIGNALS, STREET LIGHTING, AND COMMUNICATIONS

310. General Requirements

A. Signing, pavement markings, traffic signals, communication systems, and street lighting shall be furnished and installed in conformance with the current editions of the MUTCD, the Oregon supplements to the MUTCD, ODOT Standard Drawings, and the *Oregon Standard Specifications for Construction*.

320. Signing

A. Street signage shall comply with the requirements shown on Std. Drg. No. 320-1.

330. Pavement Markings

A. Striping materials and layout plan, prepared by the Engineer, shall be approved by the City prior to installation. The Engineer is also responsible for field layout subject to approval of the City.

B. Permanent pavement markings shall comply with the requirements shown on Std. Drg. No. 330-1.

C. Temporary pavement markings

1. Foil-back tape and flexible pavement markers (stick-and-stomps) may only be used, for a time period not exceeding one (1) month, in areas where traffic will not subject them to heavy wear.

2. Painted pavement markings may be used for a time period not exceeding one (1) year.

340. Traffic Signals

A. Signal poles shall be located at the back of the sidewalk. If right of way is not available at back of sidewalk, alternative locations may be submitted for City approval.

B. All new signals, signal modifications, and signal retrofits shall use video or radar detection. Detection type subject to operational needs and shall be at the discretion of the City.

C. New signals shall include underground infrastructure required for installation of loop detection. Infrastructure to include conduit, pull string, locate wire, and junction boxes at stop bar and advanced detection locations.

D. New signals, signal modifications, and signal retrofits shall include one pan-tilt-zoom (PTZ) camera, or as determined by the City.

E. The Engineer shall conduct appropriate geotechnical investigations and design signal pole foundations in accordance with ODOT Standard Drawings TM650 through TM653.

F. Pedestrian signal head indications shall include a countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change (or “don’t walk”) interval.

G. New, modified, and retrofitted traffic signals shall include an audible pedestrian signal (APS) system and ADA compliant ramps.

1. APS push buttons shall be installed on a standalone pole. Do not install push buttons on signal pole.

2. Locate push buttons within 10 inches of ADA sidewalk ramp landings, when measured horizontally.

3. Pedestrian push button poles shall be separated by at lease 10 feet.

4. Provide push button pole location and button orientation on all sidewalk ramp design plan sheets.

H. New traffic signals shall be equipped with an Advance Transportation Controller (ATC) compliant signal controller built to ODOT specifications, and be of the make and model bench tested and approved by ODOT.

I. For all traffic signal modifications and retrofits, supply new ATC signal controller built, tested, and approved by ODOT.

J. New signals shall be designed for and include a 332 Stretch signal controller cabinet.

K. Signal indicator lights shall be installed at all new, modified, and retrofitted traffic signals. One signal indicator light shall be provided for the through movement at each approach.

L. The pedestrian clearance intervals shall be in accordance with a walk speed of 3.5 feet/second.

M. Red and yellow times will be reviewed by the City or the applicable road authority. The table below provides the minimum standards for red and yellow time operation.

Table 340.1 – Red and Yellow Signal Times

Phase	Posted Speed (MPH)	Yellow Time Operation (sec.)	All Red Operation (sec.)
Thru	20	3.0	1
Thru	25	3.0	1
Thru	30	3.5	1
Thru	35	4.0	1
Thru	40	4.0	1
Thru	45	4.5	1
LT	LT	3.0	1

350. Street Lighting

350.1. General Requirements

A. All street lighting shall be designed by an Oregon licensed engineer using the provisions in this manual, and where applicable, ANSI/IES RP-8 American National Standard Practice for Roadway Lighting.

B. The following codes and references shall be used in designing all street light systems:

1. National Electrical Code (NEC).

2. Portland General Electric (PGE).

3. National Fire Protection Association (NFPA 70E)

C. The proposed light fixtures shall be 3000K color temperature and have B-U-G values no greater than 2-0-2 respectively. Figure 350.1 contains a list of all preapproved materials.

1. Fixture type shall be selected per the Ornamental Lighting Districts map available on the City of Hillsboro website.

a) Areas outside of ornamental lighting districts shall use Autobahn fixtures. See Figure 350.1, Page 10 of 10.

D. All electrical components shall be UL approved and testing lab approved from labs accepted by the State of Oregon.

E. All street light plans shall include pole, foundation, conduit, junction box, cabinets and service, lighting controls, and transformer/controller locations along with any other pertinent information.

F. The lighting plans shall include general installation notes, including the type, manufacturer, catalog number, number of LEDs, wattage, mounting height, arm length, and specification of proposed equipment. Plans shall also include the wiring and circuit diagrams. For general plan requirements see Subsection 120.

G. The lighting plans shall include photometric data such as average foot-candles, average to minimum ratio, maximum to minimum levels, and lamp lumen depreciation factor. Photometric calculations shall be provided using separate calculation zones for roadway, intersection, and pedestrian facilities. The plans shall indicate the roadway and intersection functional classifications and pedestrian conflict assumed for calculations. An electronic file of the photometric calculations shall be provided in both PDF and original lighting software format (.AGI) and the IES file(s) used in the calculations.

H. Circuits and cable runs shall be designed to provide separate and independent circuits for street lights. Wire size shall be determined by the loading and distance of each circuit. Loading calculations shall be based on the maximum loading possible for the circuit assuming all fixtures are operating at the maximum output for the highest drive current for the fixture. Wire shall be sized to limit voltage drops to a maximum of 2 percent between the utility service connection and the control panel and a maximum of 3 percent from the control panel to the most distant fixture served. Submit an electronic file of the voltage drop / line loss calculations for City approval.

I. Photometric analysis shall include only light fixtures which are within the right-of-way. Light sources on private property cannot be included in the street lighting analysis.

J. Photometric analysis shall include only light fixtures installed as part of the project for which the analysis pertains and existing light fixtures within the right-of-way. Street lighting analysis shall not include future light fixtures.

K. Lighting design shall account for a modified photometric distribution when glare shields are used.

L. The Engineer shall be responsible to provide all required traffic control during system installation.

M. The Engineer shall be responsible for making arrangements with PGE connecting the street lighting system to the local distribution system and for locating the service cabinet.

N. Street lights and poles shall be designed to be PGE Schedule 32 or Schedule 95 (by City direction only) Option C (City owned and maintained) LED lights. All Option C lights must be connected to a city owned service and meter. The City shall have final approval authority on which luminaire to be utilized based on the specific lighting application.

O. A 10-day burn-in period shall be completed prior to final acceptance of street lights by the City.

P. Engineer shall submit to the City items for materials review prior to ordering any street lighting equipment (poles, light fixtures, lighting controls, control nodes, junction boxes, foundations, services, cabinets, etc.) and pass along to the City applicable manufacturer warranties.

Q. In systems with existing lights on both sides of the street, the circuitry shall be configured such that the lights on one side of the street can be “de-energized” without affecting the operation of the lights on the opposite side of the street. A maximum of 72 hours (3 days) of outage is permissible for existing street lighting. Where work would result in an outage for all existing lights, temporary lighting in a manner acceptable to the City shall be provided. Temporary lighting of up to 1 month (30 days) shall be allowed and the Engineer shall strive to complete all street lighting work and energize lights within that timeframe.

R. A minimum of 2-inch conduit shall run between junction boxes. Between each light pole and the adjacent junction box provide two 1-inch conduits. All conduit runs shall be marked with an underground marking tape per 00960.42(e) of the *Oregon Standard Specifications for Construction*. All conduits shall be Schedule 40 PVC and all elbows shall be fiberglass. Install bushings on all conduit ends and seal the ends with an approved conduit plug. See City Standard Details.

S. Engineer shall be responsible for locating street light poles such that no portion of the pole, mast arm, or luminaire is within 10 feet of any energized line. Installation shall conform to OAR 437-002-0047 and 437-002-2316.

T. Street lighting conduit shall be placed in the joint City communications trench located under the sidewalk.

350.2. Design Standards

A. Junction Boxes

1. Junction boxes shall be no more than 3 feet from each pole served and there shall be 1 junction box for each street light pole. Install 1 junction box for each lighting controller and include 1 spare 2-inch conduit installed to the controller with a pull string. See City Standard Details.

2. All junction boxes and lids shall be open bottom polymer concrete or polymer fiberglass, with skid resistant cover marked “Street Lighting”.

3. Do not install junction boxes in sidewalk ramp or ramp wings. Junction boxes shall be placed in the following locations in order of preference, or as approved by the City:

    - Landscape strip
    - Back of sidewalk (apron required, see Std. Drg. No. 350-1)
    - Sidewalk (outside of primary walking route)

B. Cable and Wire

1. A single phase, 3 wire, 240 volt, dedicated metered service shall be provided for street lighting.

2. All wire shall be stranded copper, single conductor, type XHHW, with a 600 volt insulation (unless no insulation is provided as noted below). Solid wiring shall not be used. The minimum wire size for the lighting circuit shall be #10 AWG wire and the maximum wire size shall be #1 AWG wire. All wire splices shall occur in junction boxes.

3. Street lighting circuits shall be designed to ensure that no section of roadway shall end up completely unlit with the loss of a single circuit. The following circuit configurations apply:

    a) When lighting is provided on one side of the street, no 2 adjacent lights shall be on the same circuit.

    b) When lighting is provided on both sides of the street, each side of the street shall be on a different circuit.

    c) At unsignalized intersections with more than 1 light, the intersection lights shall be connected to a minimum of 2 circuits.

4. Wire insulation color shall conform to the following:

    a) 120 volt photo electric circuit wires: A black wire from the controller to the photo cell, red wire for the return to the cabinet shall be used.

    b) 240 volt line distribution wires: Install circuit wire pairs as shown below, with each pair of wires sharing the same insulation color. If additional circuits are required insulation color shall be approved by the City of Hillsboro.

        - 1st circuit pair = black
        - 2nd circuit pair = red
        - 3rd circuit pair = blue

- 4th circuit pair = brown
- 5th circuit pair = yellow
- 6th circuit pair = orange

c) Grounded (neutral) conductors, if needed, shall be white or natural gray.

d) Grounding electrode conductors from the light pole to the adjacent junction box shall be green insulated or bare stranded wire.

e) Equipment ground conductors in the conduit raceways shall be green insulated.

5. Color coding of each conductor shall remain consistent throughout the entire system. Factory supplied striping of conductors will be accepted when the required color insulation is not available. Color tape will not be accepted as an alternate for insulation color coding.

C. Poles and Foundations

1. All poles shall be grounded. Install a ground rod in the junction box located at each pole. Install a 1" schedule 40 PVC conduit with a #6 green insulated or bare wire from the pole to the ground rod located in each junction box. See City Standard Details.

2. All light poles shall be constructed with a nominal 2-1/2-inch by 5-inch hand hole placed approximately 2-4 feet above the ground line. In plan view, the hand hole shall be at 90 degrees from the mast arm or curb side of the pole. The hand hole shall be secured with cast aluminum or galvanized steel cover painted to match the pole and held in place with a stainless steel tamper resistant set screw.

3. Breakaway designs shall be used for light poles located along roadways with posted speeds greater than 35 mph and within the clear-zone as defined by Table 3-1 of the *Roadside Design Guide* except for those located in drainage ditches, or near bus shelters or areas of extensive pedestrian concentrations.

4. Light poles shall be set on a pre-cast concrete light foundation. Foundations shall be one of the following, or as approved by the City:

- 20R-LB-PGE
- 5CL-LB-PGE
- 4-LB-PGE
- 7-LB-PGE

D. Lighting Controller

1. The controller cabinets shall be installed away from intersections and other locations where an errant vehicle could damage the cabinet. The cabinet location should be near a side property line and should not detract aesthetically from the adjacent properties. In residential areas, locations along side yard frontages are preferred to front yard frontages. Cabinet locations should also take into consideration future system growth. Engineer should consult with City and PGE regarding cabinet location at the beginning of design.

2. The cabinet shall have a service panel that has a "Service Equipment" rated UL label attached to the panel. A 100 amp, single phase, 3 wire, 240 volt, dedicated metered service is to be provided by the developer. Each street lighting circuit shall be wired 240 volts. The street light base mounted controller shall be installed per ODOT's standard drawing TM485 and shall be on ODOT's blue sheets. The controller shall be made of stainless steel and include circuit breakers, test switch, neutral and ground bars. When only one illumination breaker is being installed, leave space for 3 additional illumination breakers. Follow NFPA 70E standards for arc flash and provide the required labeling for the controller cabinet. Attach available fault current to inside of door with a permanent label.

E. An Inline fuse shall be installed between the circuit and each light fixture on that circuit per subsections 00970.42 & 02920.26 of the *Oregon Standard Specifications for Construction*. The circuit protector shall be accessible through the hand hole.

F. All street lights shall operate at 240 volts and shall be grounded. All lighting fixtures shall be capable of varying lighting output via a dimmable LED driver connected to a 7-prong photocell socket. Field test the completed lighting system as outlined in subsection 00970.70 of the *Oregon Standard Specification for Construction*.

G. All street lights shall be controlled by the City's street light control system. Each fixture shall have a GE LightGrid control node installed in the photocell socket. The City will provide the Engineer with the applicable street lighting dimming schedule for programming and the Engineer is responsible for programming the control node information needed to add the new fixtures into the City's system. In the event that a system is brought online prior to the nodes being programmed or where no street lighting dimming schedule is required, the Engineer shall operate the lights under the control node's photocell control at designed lighting levels.

H. A gateway serves as a device to allow a group of wireless controllers to communicate with the central server using a backhaul communication mesh network. Engineer is responsible to ensure compatibility among all components of the system.

Table 350.1 – Street and Parallel On-Street Bicycle Facilities Lighting Levels

Average Maintained Illuminance on the Horizontal				
Roadway Classification	Pedestrian Conflict Area	Minimum Average Maintained in Foot Candles [1 2 3]		
		Concrete Street	Asphalt Street	Uniformity Ratio Avg. to Min.
Arterial	High	> 1.2	> 1.7	< 3:1
	Medium	> 0.9	> 1.3	< 3:1
	Low	> 0.6	> 0.9	< 3:1
Collector	High	> 0.8	> 1.2	< 4:1
	Medium	> 0.6	> 0.9	< 4:1
	Low	> 0.4	> 0.6	< 4:1
Local Road	High	> 0.6	> 0.9	< 6:1
	Medium	> 0.5	> 0.7	< 6:1
	Low	> 0.3	> 0.4	< 6:1

[1] Do not design roadways more than 1.3x above the minimum average foot candle light levels.
[2] Values reflect design light levels under peak conditions outside dimming thresholds.
[3] Includes parallel bicycle facilities that are not separated by a landscape strip.

Table 350.2 – Parallel Separated Bicycle and Pedestrian Facilities Target Lighting Levels

Average Maintained Illuminance on the Horizontal			
Location	Minimum Average Maintained in Foot Candles [1 2 3]		
	Concrete Facility	Asphalt Facility	Uniformity Ratio Avg. to Min.
> 2 dwelling units per acre	> 0.4	> 0.4	< 4:1
< 2 dwelling units per acre	> 0.3	> 0.3	< 6:1
Rural/Semi-Rural	> 0.2	> 0.2	< 10:1

[1] Do not design facilities more than 1.3x above the minimum average foot candle light levels.
[2] Values reflect design light levels under peak conditions outside dimming thresholds.
[3] For parallel bicycle facilities separated by a landscape strip and sidewalks.

Table 350.3 – Intersection Lighting Standards

Average Maintained Illuminance on the Horizontal				
Intersection Classification	Pedestrian Conflict Area	Minimum Average Maintained in Foot Candles [1 2 3]		
		Concrete Intersection	Asphalt Intersection	Uniformity Ratio Avg. to Min.
Arterial/ Arterial	High	≥ 2.4	≥ 3.4	≤ 3:1
	Medium	≥ 1.8	≥ 2.6	≤ 3:1
	Low	≥ 1.2	≥ 1.8	≤ 3:1
Arterial/ Collector	High	≥ 2.0	≥ 2.9	≤ 3:1
	Medium	≥ 1.5	≥ 2.2	≤ 3:1
	Low	≥ 1.0	≥ 1.5	≤ 3:1
Arterial/ Local Road	High	≥ 1.8	≥ 2.6	≤ 3:1
	Medium	≥ 1.4	≥ 2.0	≤ 3:1
	Low	≥ 0.9	≥ 1.3	≤ 3:1
Collector/ Collector	High	≥ 1.6	≥ 2.4	≤ 4:1
	Medium	≥ 1.2	≥ 1.8	≤ 4:1
	Low	≥ 0.8	≥ 1.2	≤ 4:1
Collector/ Local Road	High	≥ 1.4	≥ 2.1	≤ 4:1
	Medium	≥ 1.1	≥ 1.6	≤ 4:1
	Low	≥ 0.7	≥ 1.0	≤ 4:1
Local Road/ Local Road	High	≥ 1.2	≥ 1.8	≤ 6:1
	Medium	≥ 1.0	≥ 1.4	≤ 6:1
	Low	≥ 0.6	≥ 0.8	≤ 6:1

[1] Do not design intersections more than 1.3x above the minimum average foot candle light levels.
[2] Values reflect design light levels under peak conditions outside dimming thresholds.
[3] Intersection analysis area includes curb ramps and crosswalks.

Table 350.4 – Roundabout Lighting Standards

Average Maintained Illuminance on the Horizontal and Vertical [3]				
Intersection Classification	Pedestrian Conflict Area	Minimum Average Maintained in Foot Candles [1 2]		
		Concrete Intersection	Asphalt Intersection	Uniformity Ratio Avg. to Min.
Arterial/ Arterial	High	≥ 2.4	≥ 3.4	≤ 3:1
	Medium	≥ 1.8	≥ 2.6	≤ 3:1
	Low	≥ 1.2	≥ 1.8	≤ 3:1
Arterial/ Collector	High	≥ 2.0	≥ 2.9	≤ 3:1
	Medium	≥ 1.5	≥ 2.2	≤ 3:1
	Low	≥ 1.0	≥ 1.5	≤ 3:1
Arterial/ Local Road	High	≥ 1.8	≥ 2.6	≤ 3:1
	Medium	≥ 1.4	≥ 2.0	≤ 3:1
	Low	≥ 0.9	≥ 1.3	≤ 3:1
Collector/ Collector	High	≥ 1.6	≥ 2.4	≤ 4:1
	Medium	≥ 1.2	≥ 1.8	≤ 4:1
	Low	≥ 0.8	≥ 1.2	≤ 4:1
Collector/ Local Road	High	≥ 1.4	≥ 2.1	≤ 4:1
	Medium	≥ 1.1	≥ 1.6	≤ 4:1
	Low	≥ 0.7	≥ 1.0	≤ 4:1
Local Road/ Local Road	High	≥ 1.2	≥ 1.8	≤ 6:1
	Medium	≥ 1.0	≥ 1.4	≤ 6:1
	Low	≥ 0.6	≥ 0.8	≤ 6:1

[1] Do not design intersections more than 1.3x above the minimum average foot candle light levels.

[2] Values reflect design light levels under peak conditions outside dimming thresholds.

[3] Vertical illuminance is measured at a height of 5 feet in each driving direction and perpendicular to the main pedestrian flow.

Table 350.5 – Unsignalized Pedestrian/Bicycle Crossing Target Lighting Values[8]

Average Maintained Illuminance on the Horizontal and Vertical [7]			
Maintained Illuminance Values for Walkways in Foot Candles High Pedestrian Conflict Areas [1 2 6]			
Location	**E_{avg}** [3]	**EV_{min}** [4]	Uniformity Ratio [5]
Mixed Vehicle and Pedestrian	≥ 2.0	≥ 1.0	≤ 4:1
Pedestrian Only	≥ 1.0	≥ 0.5	≤ 4:1
Maintained Illuminance Values for Walkways in Foot Candles Medium Pedestrian Conflict Areas [1 2 6]			
Location	**E_{avg}** [3]	**EV_{min}** [4]	Uniformity Ratio [5]
Pedestrian Areas	≥ 0.5	≥ 0.2	≤ 4:1
Maintained Illuminance Values for Walkways in Foot Candles Low Pedestrian Conflict Areas [1 2 6]			
Location	**E_{avg}** [3]	**EV_{min}** [4]	Uniformity Ratio [5]
Rural/Semi-Rural Areas	≥ 0.2	≥ 0.06	≤ 10:1
Low Density Residential (≤ 2 dwelling units per acre)	≥ 0.3	≥ 0.08	≤ 6:1
Medium Density Residential (2.1 – 6.0 dwelling units per acre)	≥ 0.4	≥ 0.1	≤ 4:1

[1] Do not design areas more than 1.3x above the minimum average foot candle light levels.

[2] Values reflect design light levels under peak conditions outside dimming thresholds.

[3] **E_{avg}** – Minimum maintained average horizontal illuminance at the pavement surface.

[4] **EV_{min}** – Minimum vertical illuminance at 5 feet above the pavement.

[5] Ratio of **E_{avg}** to the minimum horizontal illuminance at the pavement surface.

[6] Refer to IES RP-8-14 for additional guidance regarding these tables.

[7] Vertical illuminance is measured at a height of 5 feet in both directions and parallel to the main pedestrian flow.

[8] Target values for mid-block and RRFB enhanced crossings.

Figure 350.1 – Preapproved Equipment (Page 1 of 10)

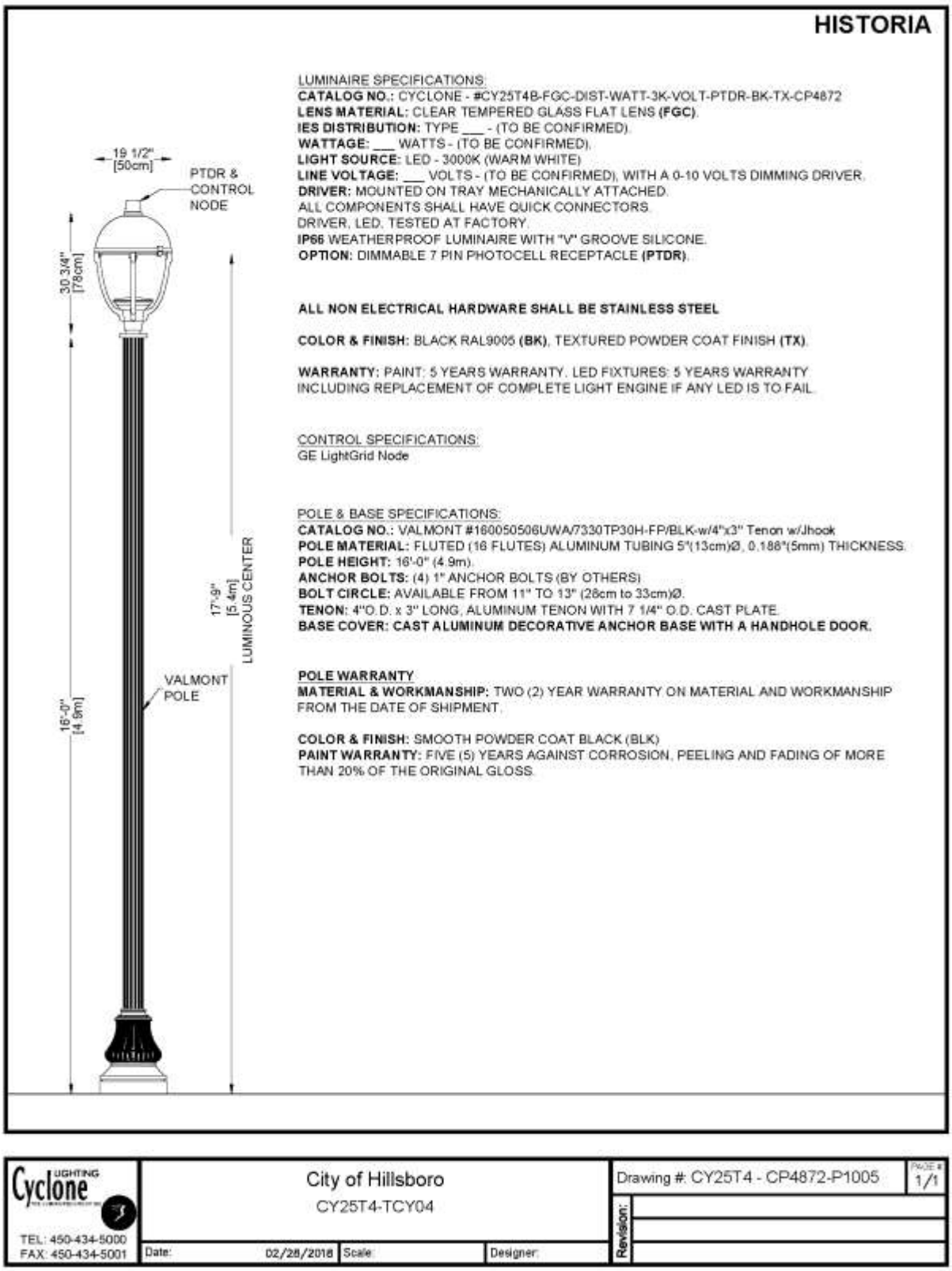


Figure 350.1 – Preapproved Equipment (Page 2 of 10)

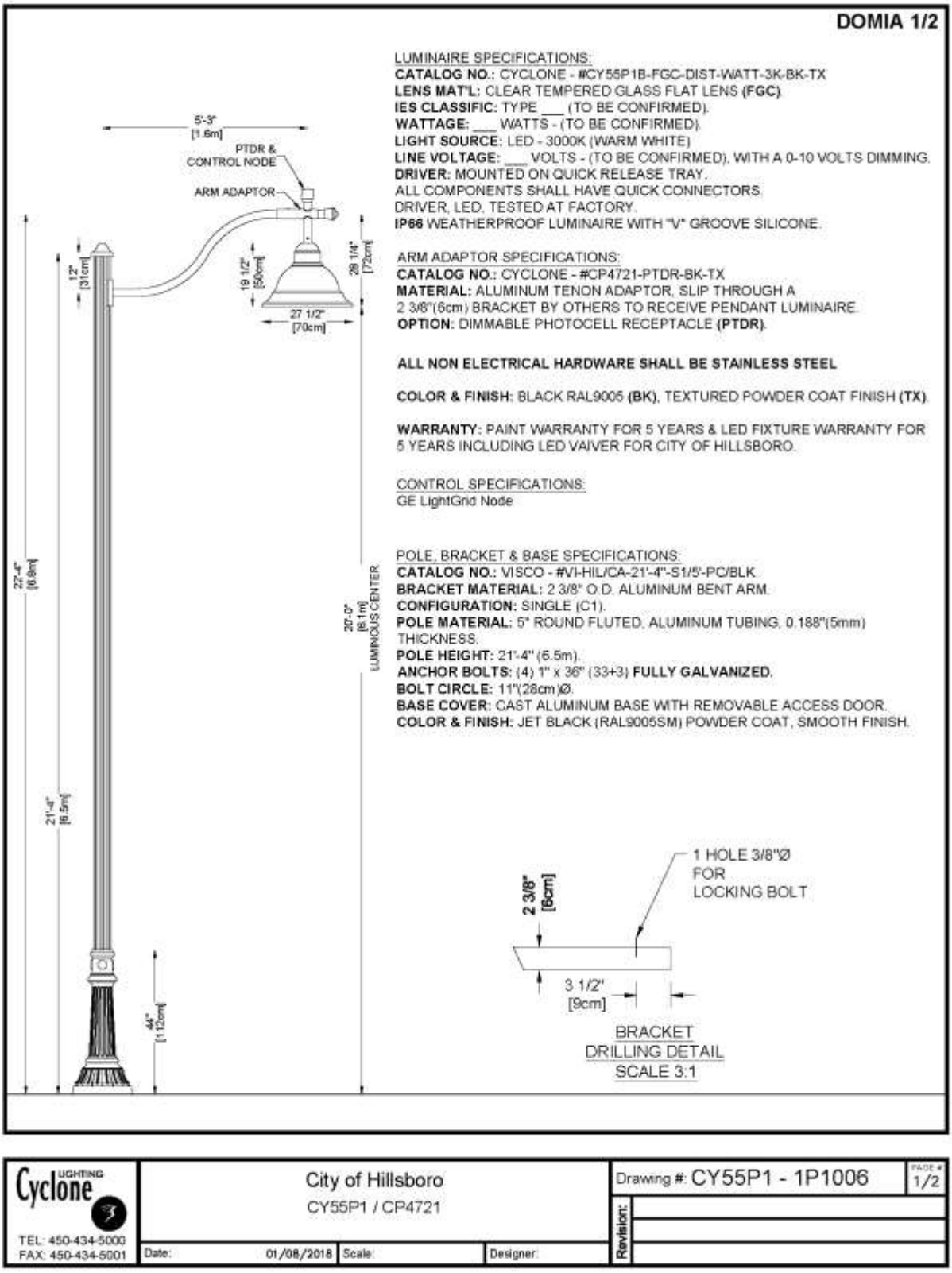


Figure 350.1 – Preapproved Equipment (Page 3 of 10)

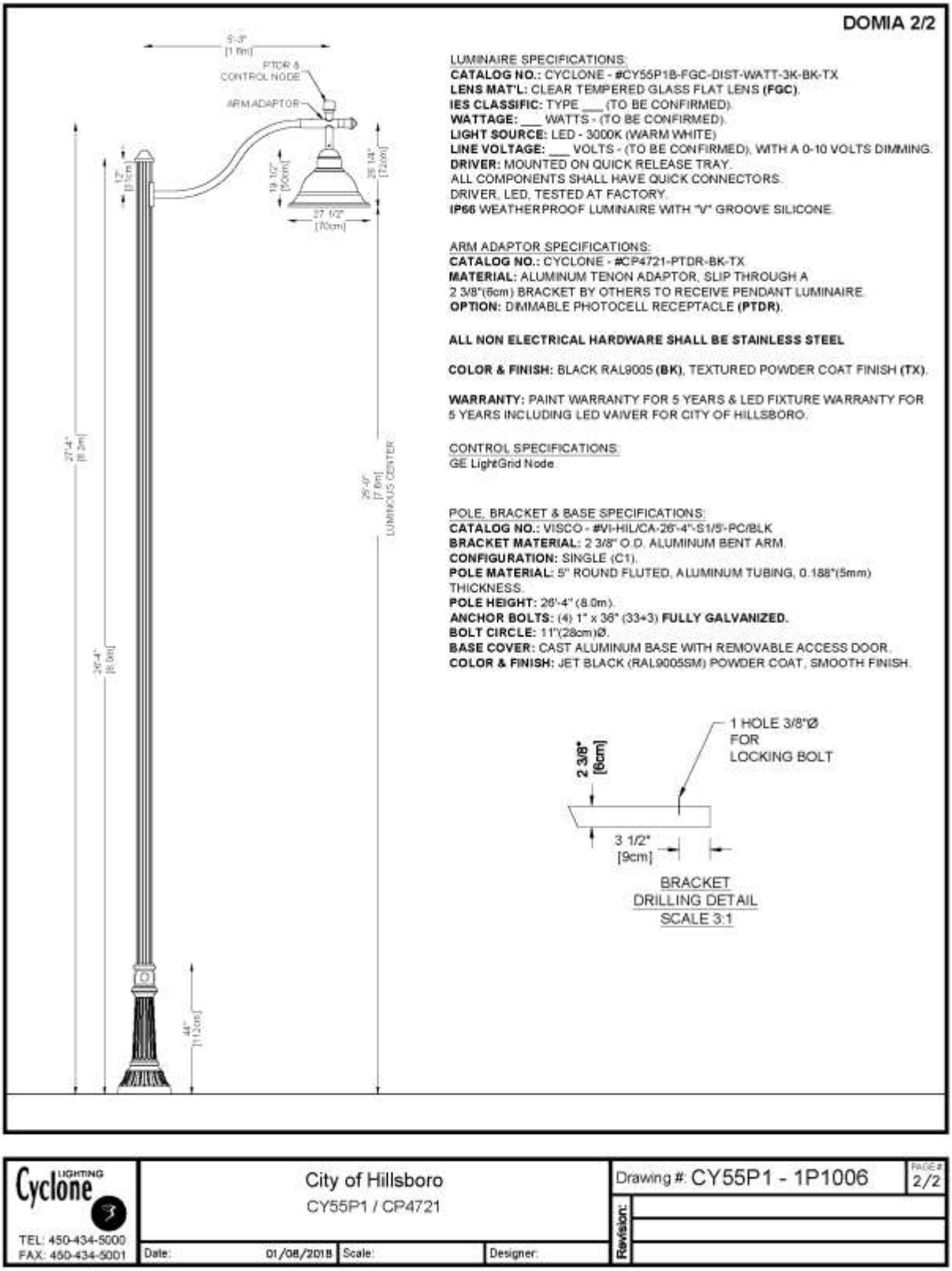
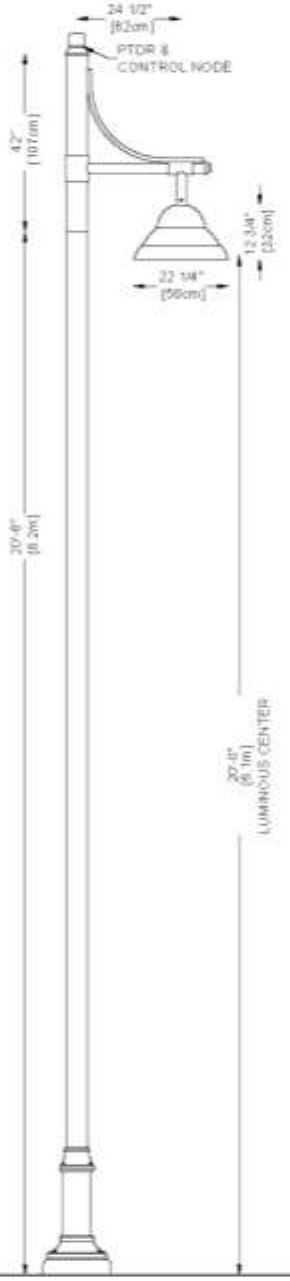


Figure 350.1 – Preapproved Equipment (Page 4 of 10)

NEW ERA SHORT 1/2



LUMINAIRE SPECIFICATIONS:
CATALOG NO.: CYCLONE - #NEL3001P1-FGC-DIST-WATT-3K-VOLT-BK-TX-CP5121
LENS MAT'L: CLEAR TEMPERED GLASS FLAT LENS **(FGC)**.
IES CLASSIFIC: TYPE ____ - (TO BE CONFIRMED).
WATTAGE: ___ WATTS - (TO BE CONFIRMED).
LIGHT SOURCE: LED - 3000K (WARM WHITE)
LINE VOLTAGE: ___ VOLTS - (TO BE CONFIRMED), WITH A 0-10 VOLTS DIMMING.
DRIVER: MOUNTED ON QUICK RELEASE TRAY.
ALL COMPONENTS SHALL HAVE QUICK CONNECTORS.
DRIVER, LED, TESTED AT FACTORY.
IP66 WEATHERPROOF LUMINAIRE WITH "V" GROOVE SILICONE.

BRACKET SPECIFICATIONS:
CATALOG NO.: CYCLONE - #M204-C1-T50-PTDR-BK-TX
MATERIAL: CENTRAL TUBING 5"(13cm)Ø MADE OF ALUMINUM WITH ONE ARM 2 3/8"(6cm)Ø A DECORATIVE ELEMENT AND TENON FOR LUMINAIRE, WELDED TOGETHER.
CONFIGURATION: SINGLE (C1).
OPTION: DIMMABLE PHOTOCELL RECEPTACLE **(PTDR)**.

CONTROL SPECIFICATIONS:
GE LightGrid Node

POLE SPECIFICATIONS:
CATALOG NO.: CYCLONE - #PS50-20'-6"-SA-T50-BK-TX.
MATERIAL: 5" ROUND, STEEL TUBING, 0.125"(3mm) THICKNESS.
POLE HEIGHT: 20'-6" (6.2m).
ANCHOR BOLTS: (4) 1" x 36" (33+3) **FULLY GALVANIZED.**
BOLT CIRCLE: 11 1/2" (29cm)Ø. AVAILABLE FROM 8" TO 12" (20cm to 30cm)Ø.

BASE COVER SPECIFICATIONS:
CATALOG NO.: CYCLONE - #BD57-BK-TX
MATERIAL: TWO-PIECE COVER MADE OF CAST ALUMINUM.

ALL NON ELECTRICAL HARDWARE SHALL BE STAINLESS STEEL

COLOR & FINISH: BLACK RAL9005 **(BK)**, TEXTURED POWDER COAT FINISH **(TX)**.

WARRANTY: PAINT WARRANTY FOR 5 YEARS & LED FIXTURE WARRANTY FOR 5 YEARS INCLUDING LED VAIVER FOR CITY OF HILLSBORO.

Cyclone LIGHTING
TEL: 450-434-5000
FAX: 450-434-5001

City of Hillsboro
NEL3001P1 / M204-C1 / PS50-BD57

Drawing #: NEL3001P1 - 1P1001 PAGE # 1/2

Revision:

Date: 01/08/2018 Scale: Designer:

Figure 350.1 – Preapproved Equipment (Page 5 of 10)

Figure 350.1 – Preapproved Equipment (Page 6 of 10)

NEW ERA TALL 1/4

LUMINAIRE SPECIFICATIONS:
CATALOG NO.: CYCLONE - #NEL30S-FGC-DIST-WATT-3K-VOLT-PTDR-BK-TX
LENS MAT'L: CLEAR TEMPERED GLASS FLAT LENS **(FGC)**.
IES CLASSIFIC: TYPE ____ - (TO BE CONFIRMED).
WATTAGE: ___ WATTS - (TO BE CONFIRMED).
LIGHT SOURCE: LED - 3000K (WARM WHITE)
LINE VOLTAGE: ___ VOLTS - (TO BE CONFIRMED), WITH A 0-10 VOLTS DIMMING.
DRIVER: MOUNTED ON QUICK RELEASE TRAY.
ALL COMPONENTS SHALL HAVE QUICK CONNECTORS.
DRIVER, LED, TESTED AT FACTORY.
IP66 WEATHERPROOF LUMINAIRE WITH "V" GROOVE SILICONE.
OPTION: DIMMABLE PHOTOCELL RECEPTACLE **(PTDR)**.

ALL NON ELECTRICAL HARDWARE SHALL BE STAINLESS STEEL

COLOR & FINISH: BLACK RAL9005 **(BK)**, TEXTURED POWDER COAT FINISH **(TX)**.

WARRANTY: PAINT WARRANTY FOR 5 YEARS & LED FIXTURE WARRANTY FOR 5 YEARS INCLUDING LED VAIVER FOR CITY OF HILLSBORO

CONTROL SPECIFICATIONS:
GE LightGrid Node

POLE, BRACKET & BASE SPECIFICATIONS:
CATALOG NO.: VALMONT #261045806T4/1TA0650H35/40RPTSC-CH22AC08142-FP/BLK
BRACKET MATERIAL: CENTRAL TUBING 4"(10cm)Ø MADE OF ALUMINUM WITH A 2 3/8"(6cm)Ø ARM & A DECORATIVE ELEMENT, WELDED TOGETHER.
ARM LENGTH: 6'-0" (1.8m)
CONFIGURATION: SINGLE (C1).
POLE MATERIAL: TAPERED ALUMINUM TUBING, 0.188"(5mm) THICKNESS.
POLE HEIGHT: 26'-9" (8.2m).
ANCHOR BOLTS: (4) 1" x 36" (33+3) **FULLY GALVANIZED.**
BOLT CIRCLE: AVAILABLE FROM 11" TO 12" (28cm to 30cm)Ø.
BASE COVER: ROUND SHAPE, TWO PIECE COVER.

POLE WARRANTY
MATERIAL & WORKMANSHIP: TWO (2) YEAR WARRANTY ON MATERIAL AND WORKMANSHIP FROM THE DATE OF SHIPMENT.

COLOR & FINISH: SMOOTH POWDER COAT BLACK (BLK)
PAINT WARRANTY: FIVE (5) YEARS AGAINST CORROSION, PEELING AND FADING OF MORE THAN 20% OF THE ORIGINAL GLOSS.

Cyclone LIGHTING
TEL: 450-434-5000
FAX: 450-434-5001

City of Hillsboro
NEL30S - 30' MH - 6' LA

Drawing #: NEL30S - 1P1002 | 1/4

Revision:

Date: 01/08/2018 | Scale: | Designer:

Figure 350.1 – Preapproved Equipment (Page 7 of 10)

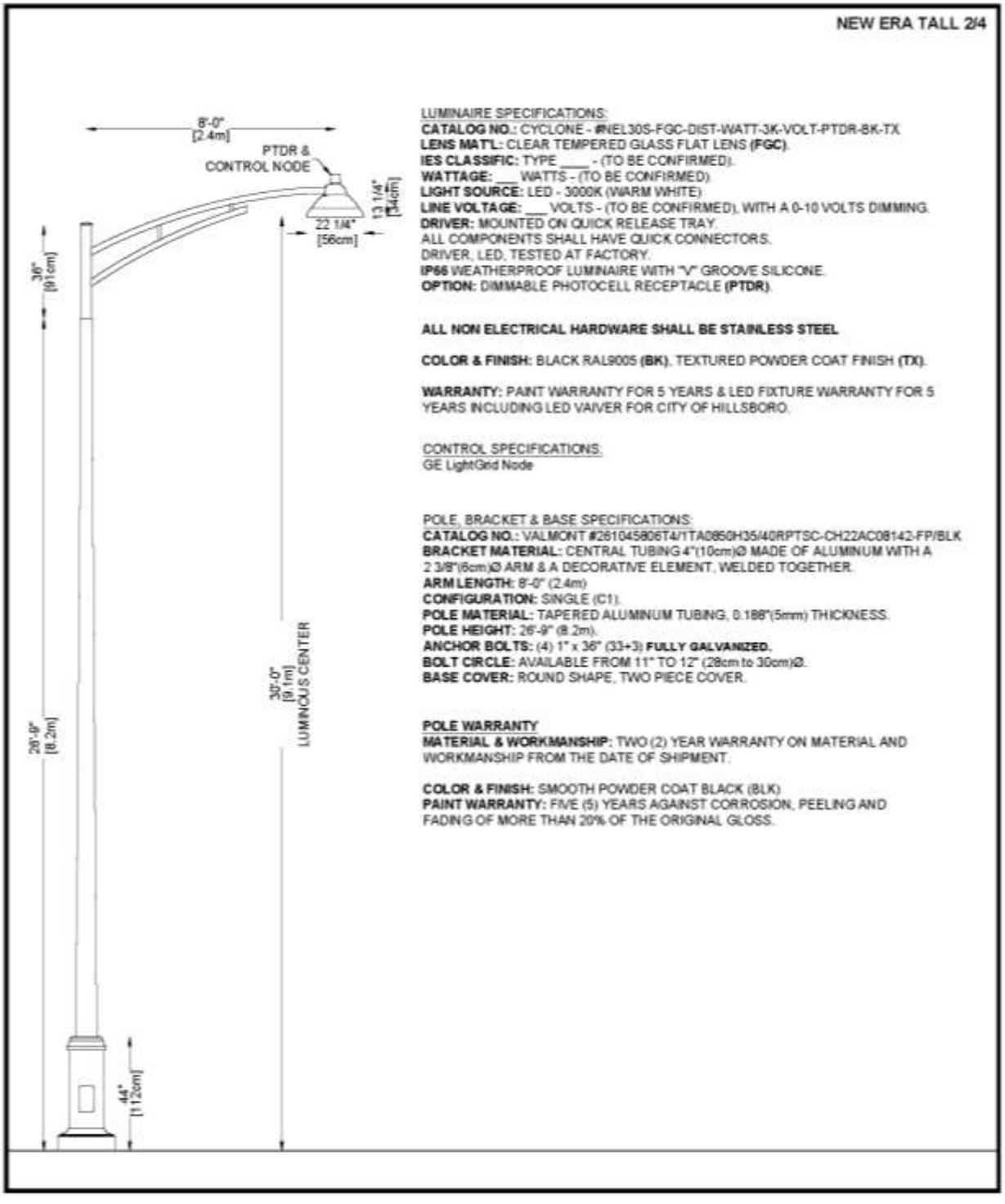


Figure 350.1 – Preapproved Equipment (Page 8 of 10)

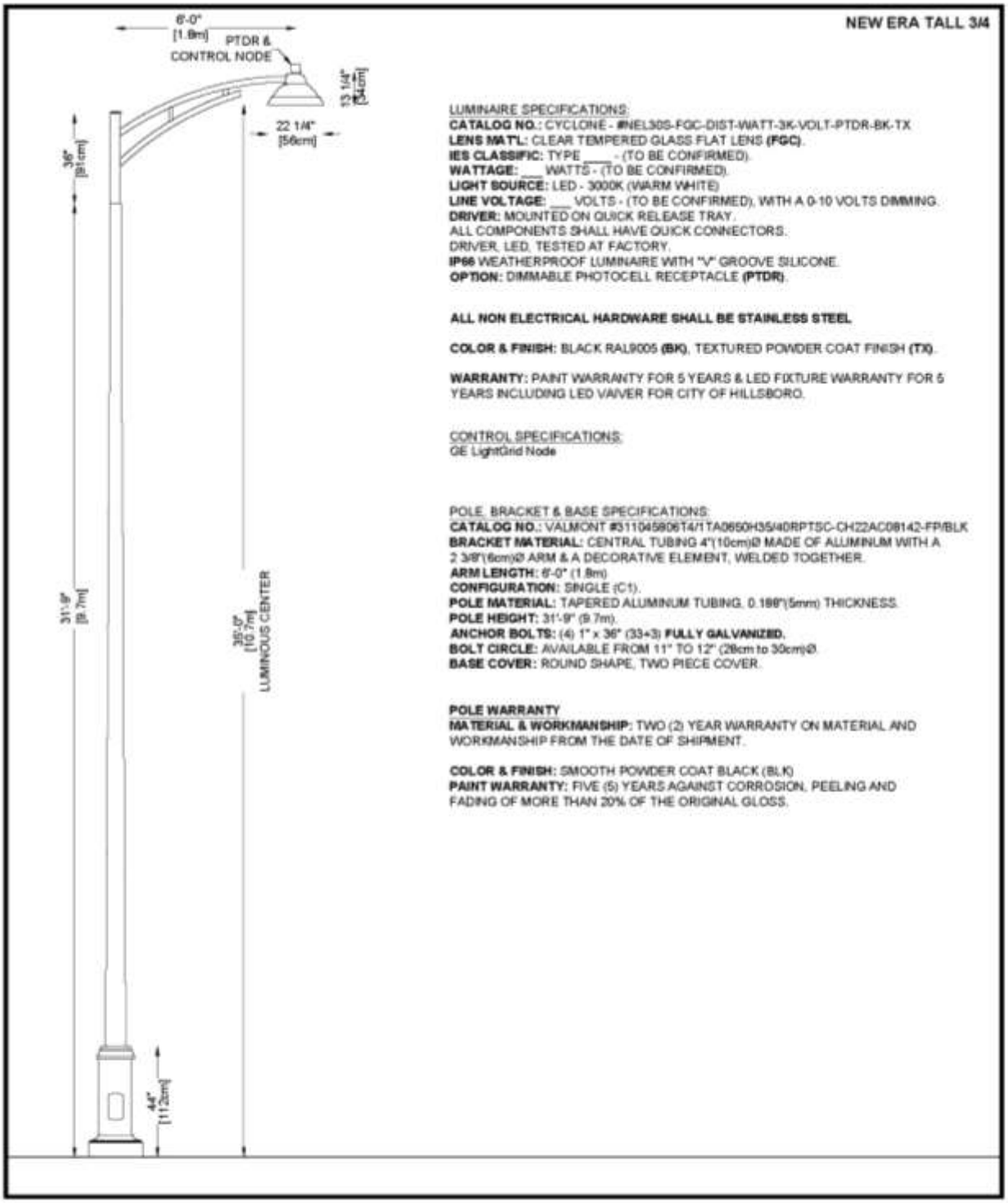


Figure 350.1 – Preapproved Equipment (Page 9 of 10)

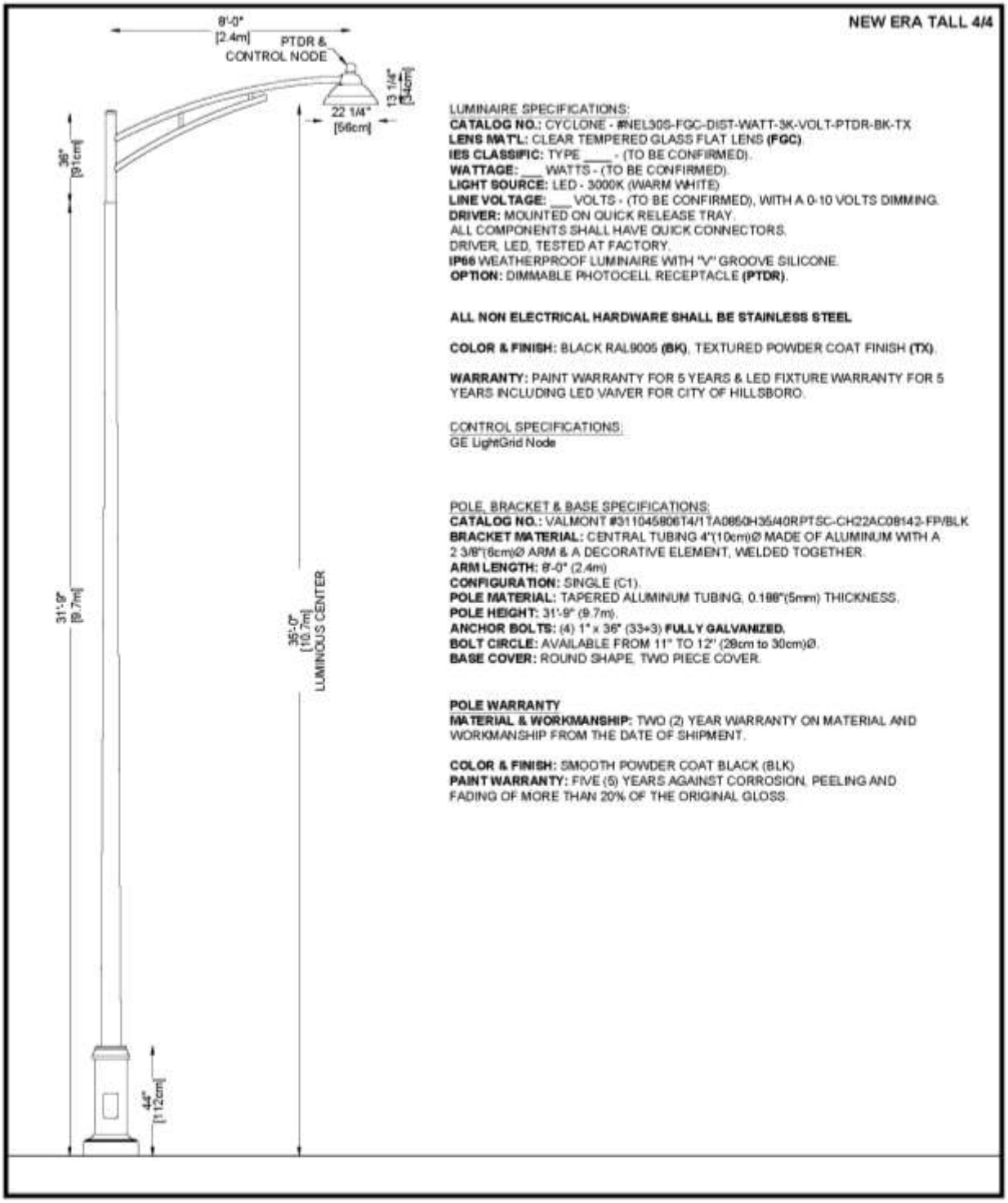
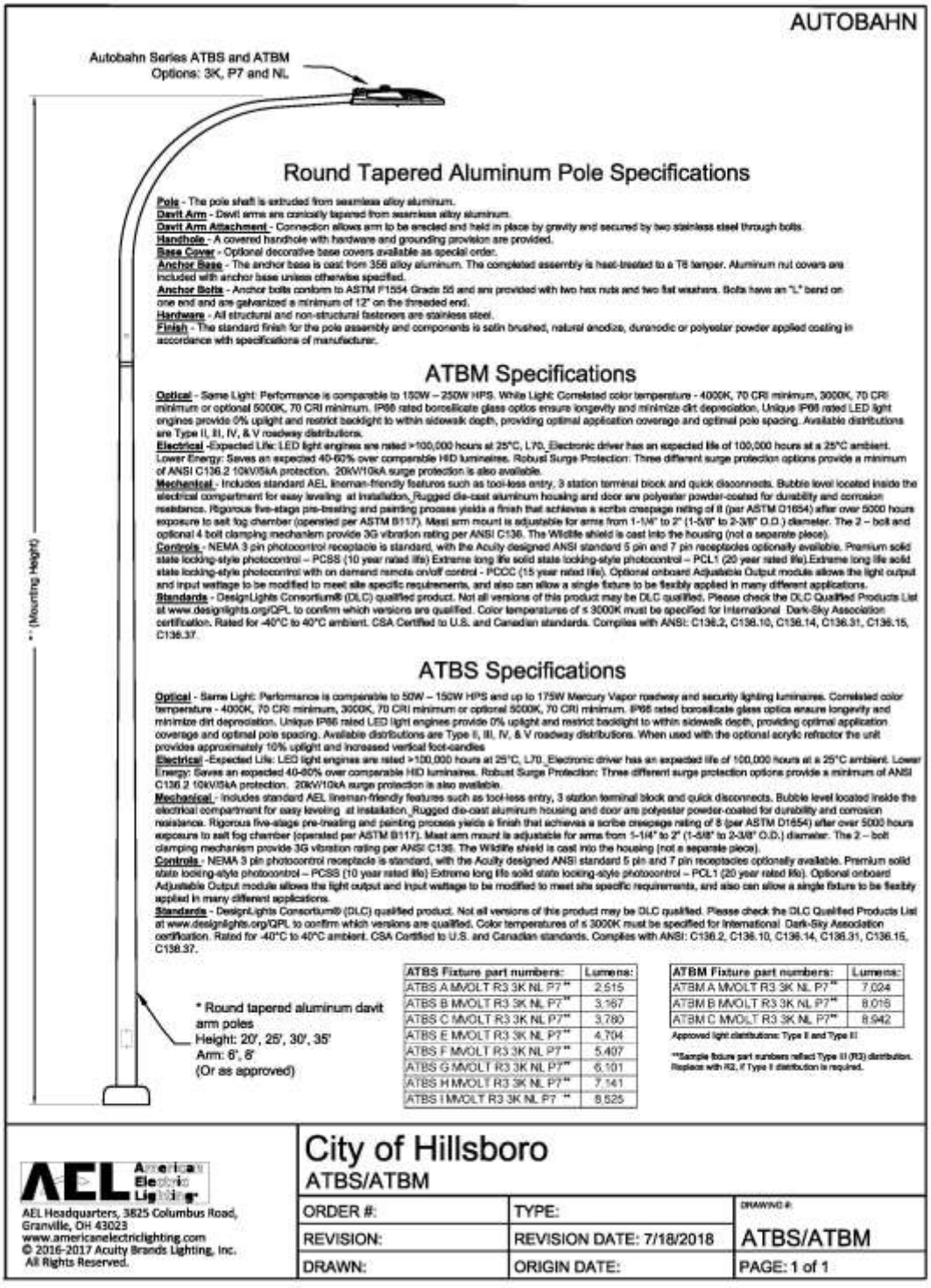


Figure 350.1 – Preapproved Equipment (Page 10 of 10)



360. Communications

360.1. General Design Requirements

A. Install conduit and communications junction boxes to create a complete raceway system. Install fiber optic cables and related equipment on corridors specified in the City's Transportation Communications Plan. Test the fiber optic system and document the results.

B. Install conduit and communications junction boxes on both sides of roadway within City right of way or utility easement. If project work is only on one side of roadway, conduit and junction boxes may only be needed on that side depending on plan review by the City.

C. All conduit and junction box raceway networks must form a single connected system. Ensure conduit system connects to existing traffic signal controller cabinets, traffic signal interconnect, and communications conduit.

D. Install three 2-inch conduits along roadway and two 2-inch conduits into traffic signal controller cabinets. Install poly pull line and tracer wire in each conduit.

1. Conduit shall be located per Figure 210.7. See Subsection 210.2.C.

E. Install communications junction boxes at the corners of intersections and within 25 feet of traffic signal controller cabinets.

F. Install conduit and junction boxes only on roadways classified by the Transportation System Plan as Collector or Arterial.

G. For roadways identified in the Transportation Communications Plan:

1. Install one 144 strand single mode fiber optic cable on one side of the roadway as directed by City staff.

2. At traffic signal controller cabinets install a splice closure in the adjacent communications junction box, one 12 strand single mode fiber optic cable to cabinet, and fiber optic termination equipment. Fusion splice and terminate fiber optic cable in the cabinet. Perform 4 additional fusion splices in splice closure as directed by City staff.

3. Install fiber optic cable slack storage loops equal to 10% of the total cable length, distributed throughout the cable length. Include minimum 25 feet cable slack with each cable at fiber optic distribution units and splice closures.

360.2. Materials

A. Conduit

1. General

a) Conduits shall be sized according to the requirements of the National Electric Code (NEC) current edition.

b) Separate conduits shall be used for low voltage and high voltage circuits, such as: signal circuits, detector circuits, service wires, communications wires, and 240 volt or greater illumination circuits.

2. Conduit material shall be polyvinyl chloride (PVC) schedule 40 or high density polyethylene (HDPE) schedule 40. Rigid non-metallic fiberglass schedule 40 conduit shall be used for all conduit bends or sweeps.

3. Sweeps

   a) Conduit sweeps shall be minimum 36 inch radius.

   b) Conduit shall have no more than 360 total degrees of bend.

4. Conduit shall be installed at a depth of 30 inches below finished ground surface.

5. Install an electrical poly pull rope with minimum 1,200 pound break strength in all conduits.

6. Install a 16 AWG THWN locate wire with orange jacket and blue tracer in all conduit. Extend the wire 2 feet beyond the conduit end and install wire nut.

7. A single locatable pull line meeting the requirements of the poly pull line and locate wire may be used in place of individual poly pull line and locate wire.

8. Install push-on bell style bushings on ends of conduit.

9. Provide underground marking tape that is red polyethylene film, 6 inches wide, 4 mils thick minimum, and imprinted with the following or similar legend: "CAUTION CAUTION CAUTION BURIED ELECTRIC LINE".

B. Communication Junction Box

1. Communication junction boxes are large style polymer concrete for use in underground systems. The communication junction boxes are used to accommodate the large bending radius of fiber optic cabling and to provide room for cable storage. Install in non-deliberate vehicular traffic areas only.

2. Communications junction boxes at intersections shall be 3 feet by 3 feet with a depth of 3 feet. Junction boxes along the communication path used for pulling and storage shall be 3 feet by 2 feet with a depth of 2 feet.

3. Materials shall consist of aggregate bonded with a polyester resin and reinforced with fiberglass strands. The communication junction box and cover shall be gray in color. Covers shall meet AASHTO H-20/HS-20 specifications for loads. Covers shall have a skid resistant surface and bolt to the box with stainless steel hex head bolts. The size of the communication junction box shall be as shown.

4. Communication junction boxes shall be installed with a 12 inch concrete apron if located outside a paved or concrete area.

5. Junction box covers shall have the legend “COMMUNICATION” or “FIBER” stamped or embossed on the cover as appropriate. Letter size shall be no smaller than 1/16 of the box width. City will install metal asset tags on all junction boxes.

C. Fiber optic cable – See Subsection 370.

D. Network cable

1. Industrial Ethernet cables shall be Waterblock/direct burial rated, shielded enhanced, Category-6 cable with 24 AWG solid bare copper conductors, PE inner jacket, overall shield, and sunlight and oil resistant PE jacket. Terminate cable with RJ-45 connectors. The cable must be rated for minimum 300 V or UL 444 listed.

2. Patch cables shall be unshielded Category-6 cable with 24 AWG stranded, bare copper conductors and factory terminated with RJ-45 connectors and strain relief boots. The outer jacket shall be pink in color.

E. Network equipment

1. The Fiber Edge Switch must meet the following requirements:

- Two Gigabit Ethernet SFP ports with paired SFP transceivers
- Eight 10/100Base-TX Ethernet ports
- 35mm DIN rail mount
- Operating voltage: 120 V AC
- Include power cable
- Support Rapid Spanning Tree Protocol (IEEE 802.1w)
- Support Quality of Service (IEEE 802.1p)
- Support VLAN (IEEE 802.1Q) with double tagging and GVRP support
- Support Link Aggregation (IEEE 802.3ad)
- Operating temperature range: -29°F to 165°F

2. The Fiber Aggregate Switch must meet the following requirements:

- Eight Gigabit Ethernet SFP ports with paired SFP transceivers
- One 10/100/1000Base-TX Ethernet port
- 19 inch rack mount
- Operating voltage: 120 V AC
- Include power cable
- Support Rapid Spanning Tree Protocol (IEEE 802.1w)
- Support Quality of Service (IEEE 802.1p)
- Support VLAN (IEEE 802.1Q) with double tagging and GVRP support

- Support Link Aggregation (IEEE 802.3ad)
- Operating temperature range: -29°F to 165°F

3. Single strand bi-directional SFP transceiver for Gigabit Ethernet switches must be provided in matched pairs and meet the following requirements:

- One LC single mode fiber connector
- Nominal transmission distance 10 km
- Hot swappable
- Support 1000Base-BX
- Transmit power: -9.0 to -3.0 dBm
- Receiver sensitivity: -19.5 to -3.0 dBm
- Wavelengths: 1310 nm and 1490 nm
- Operating temperature range: -29°F to 165°F

F. Fiber optic communications bracket for powering and mounting DIN rail equipment in traffic signal controller or ITS cabinets. The communications bracket must meet the requirements defined in ODOT's standard specification for Microcomputer Signal Controller Appendix B.

G. ITS Cabinet

1. Ground mounted traffic style (332) cabinet with 8 inch riser frame and foundation. The cabinet must be UL 50 Type 3R listed. The cabinet must consist of Housing #1 and Mounting #1 cage assemblies as defined in ODOT's standard specification for Microcomputer Signal Controller. Provide the housing requirements listed in Chapter 6 Section 2 with the exception of the police panel. The cabinet assembly must be assembled and listed by a certified UL 508A panel shop or have the final assembly certified by an approved National Recognized Testing Laboratory.

2. The cabinet must come equipped with a filtered, forced air ventilation system and light. Light must automatically turn on when cabinet doors are opened.

3. All incoming 120 V circuits must terminate on terminal blocks. All terminal blocks must be UL 1059 listed. For No. 10 AWG conductors or smaller, use sectional, double terminal, barrier type terminal blocks with binder screw terminals. Terminal ampacities must be equal to or greater than conductor ampacities. For No. 8 AWG conductors or larger, use one-piece for factory assembled, sectional, barrier type terminal blocks with box lug terminals having a pressure plate between screw and conductor. Use terminals of the correct size for the conductor to be connected.

4. Bus bars must be sized to accommodate required connections and must be amperage rated for use.

5. Source power circuit must be protected by a main circuit breaker. All branch circuits must be protected by branch circuit breakers. All circuit breakers must be UL 489 listed.

6. Receptacles must be general purpose, NEMA 5-15R, duplex, white, specification grade, rated 15A, 125 V, 3 wire, grounding type, with screw terminals. Mount within receptacle box and install cover plate. All receptacles must be UL 498 listed.

7. Provide a rack mounted line conditioner in the cabinet that automatically regulates the incoming voltage from brownouts, overvoltages, and transient surges for the protection of electrical equipment. The line conditioner must use a transformer based voltage correction circuit for maintaining nominal 120 V AC +/- 5%, 60 Hz output with 90 V to 139 V AC, 60 Hz input; support minimum 1440 watt load; provide minimum 1,440 joules surge suppression; and be UL 1012 listed. Line conditioner must provide minimum 10 receptacles.

360.3. Installation, Setup, and Finishing Requirements

A. Conduit Installation

1. All conduit runs shall be as direct as possible from point to point, shall remain within right-of-way, shall connect with adjacent existing conduits as appropriate to form communications network, and maintain as straight an alignment as possible. Make conduit runs continuous between any pole, junction box, or cabinet. Use the same size conduit for the entire length, outlet to outlet.

   a) Communications conduit shall be placed in the join City communications trench located under the sidewalk.

2. Ream the ends of all conduits to remove burrs and rough edges. Plug or cap all conduit ends until wiring is installed. After wiring is installed install duct seal compound or precut closed cell polyethylene foam that will prevent debris from entering the conduit system.

3. Install all conduits at a minimum 30-inch depth under roadways and shoulders, and minimum 18 inch depth in all other areas.

4. In areas to be paved or landscaped, place all conduit before paving or landscaping.

5. Install underground marking tape above all buried conduit, 6 inches below surface.

B. Communication Junction Box Installation

1. For communication junction box installation location requirements, see Subsection 350.2.3.

2. Install communications junction boxes no more than 500 feet apart.

3. Install the tops of junction boxes flush with the surrounding grade, sidewalk, or top of curb. If installed outside roadways or shoulders, install a 12-inch Portland cement concrete apron around the junction box. In boxes having an open bottom, construct a sump of well graded 3/4-inch - 0 crushed gravel, 12 inches deep covering the approximate area of the box. Do not install conductors until the sump has been constructed.

C. Fusion splicing requirements
   1. Use individual fusion type splices to join fibers in fiber optic cables and pigtails.
   2. Apply appropriate protective coating to all splices, protect with a thermal shrink sleeve, and place in a splice tray. Loop individual fibers one full turn within splice tray to avoid micro-bending. Maintain two-inch minimum bend radius during installation and after placing in optical fiber splice tray. Individually restrain each fiber in splice tray. Place optical fibers in the splice tray so that there is no discernible tensile force on optical fiber.
   3. Perform all splice work in a controlled, weatherproof, dust-proof environment.
   4. Splicing equipment must be in good working order, have been properly calibrated within the past six months, and meet all industry standards. Prepare cables, install closures and splice fibers in accordance with accepted and approved industry standards.
   5. Individuals performing fiber optic terminations and splices must have a minimum of two years' experience terminating, splicing, and testing fiber optic cable, and possess either a Fiber Optics Installer or Fiber Optics Technician Certification recognized by the Electronics Technicians Association (ETA) or a Fiber Optics for ITS certificate from the International Municipal Signal Association (IMSA).

D. Furnish and deliver all network equipment to the City. City staff will configure and install network equipment.

E. Furnish, stow, and protect all patch cords and jumpers at network equipment locations. Unless otherwise specified, City staff will connect patch cords and jumpers.

F. Install FDUs with sufficient quantity and type of port capacities, cassettes, splice trays, and coupler plates.

G. Attach splice closure to the inside wall of communications junction boxes. Maintain sufficient clearance for routing of the fiber optic cables without exceeding the minimum bending radius of any cable. Flash-test the closure after completion of splicing work to manufacturer's recommended pressure.

H. Installed fiber optic system shall meet the following limits:
   1. Cable attenuation at 1310nm: < 0.40 dB/km
   2. Cable attenuation at 1550nm: < 0.30 dB/km
   3. Connector insertion loss: < 0.75 dB (bi-directional average)
   4. Connector return reflection: < -40 dB
   5. Fusion splice: < 0.10 dB (bi-directional average)

360.4. Documentation

A. Labels

1. Install labels to identify cables and jumpers at all termination points, communications junction boxes, and cabinets. Install labels to identify all communications components and devices in cabinets.

2. Use yellow or white colored labels with permanent black lettering. Labels must be mechanically imprinted. Do not use handwritten labels. Use tubular plastic labels on cables and jumpers.

3. Include the following information on labels:

    - Owner
    - Number of fibers
    - Purpose (e.g. intersection served)
    - Cable or connection origin
    - Cable or connection destination

B. Warning Tags

1. All warning tags must be of a long life material, orange in color, and marked in a permanent and consistent manner with black lettering. Include the text “CAUTION FIBER OPTIC CABLE” on all warning tags and show the cable fiber count.

2. Attach warning tags to fiber optic cables using UV-resistant zip ties according to the manufacturer’s recommendations. Do not affix in a manner that will cause damage to the fiber optic cables. Attach warning tags to the cables in at least two locations in communications junction boxes and at least one location in cabinets.

C. Design Drawing Requirements

1. Provide communication system plans sheets with traffic signal plans. Communication plans must consist of at least the following. For general plan requirements see Subsection 120.

    - Raceway and Cable Installation Plan
    - Fiber Optic Splicing Diagram
    - Network Equipment Connection Diagram
    - Communications Equipment Schedule

2. Mark record drawings with each installed cable’s length sequential marking at each cable entry to communications junction box, cabinet, and at each splice closure and fiber optic distribution unit. For general record drawing requirements see Subsection 120.6.

Table 360.1 – Approved Communications Materials

Section	Item Name	Approved Make/Model
360.2.A	Conduit	See ODOT Blue Sheets
360.2.A	Conduit Fittings	See ODOT Blue Sheets
360.2.A	Locatable Pull Line	
360.2.A	Underground Marking Tape	See ODOT Blue Sheets
360.2.B	Communications Junction Box	Synertech Underground Products, Strongwell, Quazite
360.2.D	Industrial Ethernet Cable	
360.2.D	Network Patch Cable	
360.2.E	Fiber Edge Switch	Siemens Ruggedcom 6GK6090-0GS23-0BA0-Z A01
360.2.E	Fiber Aggregate Switch	Siemens Ruggedcom 6GK6022-0AS23-0DC0-Z A07+B07+C07+D07+E01
360.2.E	SFP Transceivers (pair)	Siemens Ruggedcom SFP1132-1BX10R and SFP1132-1BX10T
360.2.F	Communications Bracket	See ODOT Green Sheets
360.2.G	ITS Cabinet	

Figure 360.1 – Communications Plans Standard Callouts

POLES

- EX / 1 — Retain and protect existing power pole (Power source)
- EX / 2 — Retain and protect existing utility pole
- EX / SP — Retain and protect existing signal pole
- EX / MP — Retain and protect existing traffic signal mast arm pole
- EX / LP — Retain and protect existing luminaire pole
- EX / WP — Retain and protect existing wood pole
- RIS — Install conduit riser on pole. Coordinate size and location with utility

WIRES & CABLES

- EX / W — Retain and protect existing wiring
- EX / 39 — Retain and protect existing messenger cable
- EX N / P — Retain and protect existing (N=number) twisted pair interconnect cable
- EX FO N / X — Retain and protect existing (N=number) single mode fiber optic cable owned by (X=jurisdiction)
- EX / NET — Retain and protect existing network cable
- EX / LW — Retain and protect existing locate wire
- EX / PL — Retain and protect existing pull line
- FO N / X — Install (N=number) single mode fiber optic cable for ownership by (X=jurisdiction)
- NET — Install network cable
- LW — Install locate wire
- PL — Install poly pull line
- RX / W — Remove existing wiring
- RX N / P — Remove (N=number) twisted pair interconnect cable
- RX FO N / X — Remove existing (N=number) single mode fiber optic cable owned by (X=jurisdiction)
- RX / LW — Remove existing pull line
- RX / PL — Remove existing locate wire
- RR / W — Remove and relocate existing wiring
- RI / W — Reinstall existing wiring

CABINETS

- EX / C — Retain and protect existing cabinet
- EX / SC — Retain and protect existing service cabinet
- EX / ITS — Retain and protect existing ITS cabinet
- ITS / C — Install model 332 ITS cabinet
- DIN / F — Install Fiber Optic Interconnect Communications Bracket
- COM — See communication component schedule for cabinet communications equipment

JUNCTION BOXES

- EX / JB — Retain and protect existing junction box
- JB / C — Install communications junction box
- SPC — Install fiber optic splice closure.
- RX / JB — Remove existing junction box
- RX / SPC — Remove existing fiber optic splice closure
- RR / SPC — Remove and relocate existing fiber optic splice closure
- RI / SPC — Reinstall existing fiber optic splice closure

CONDUITS

- S EX / CC — Retain and protect existing (S=size when shown) inch communications conduit
- S — Install (S=size) inch electrical conduit
- CJ — Splice new conduit to existing conduit
- CS — Cap conduit stub (for future use)
- HDD — Install conduit by horizontal directional drilling
- S RX / CC — Remove existing (S=size when shown) inch communications conduit
- S AX / CC — Abandon existing (S=size when shown) inch communications conduit

JURISDICTIONS

CoH = City of Hillsboro
CoB = City of Beaverton
WaCo = Washington County
ODOT = Oregon Depertment of Transportation

370. Optical Fiber Backbone Cabling

370.1. General

A. Scope

1. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of horizontal optical fiber infrastructure as described on the drawings and/or required by these specifications.

    a) Installation, splicing, termination, testing, labeling and documentation of new fiber optic communication cable as specified and on the drawings.

    b) The installation environment could include tie in and coordination with existing and new optical fiber and copper facilities, underground duct banks, and direct-buried conduit.

    c) The Contractor shall be responsible for: placement of cable, installation and attachment of cable to support devices within the underground structures and pole lines, the placement of conduit, the installation of pull-boxes, the furnishings of fiber optic splice closures, and installation of termination hardware, and other as specified by the City.

    d) Contractor shall be responsible for providing and installing grounding and bonding materials, duct plugs, and fire stopping materials as required completing the installation.

    e) Other incidental hardware and appliances, necessary for the proper performance and operation of the communication cable system, which are consistent with the practices of cable installation, are to be provided by the Contractor as required to complete the installation.

    f) Contractor is responsible to ensure that utility locating has been performed as per the requirements of Oregon One Call. The Contractor is responsible for any damages to any utility caused during construction. In any area where a utility has been located, work activity must be verified through pot holing.

2. The Contractor shall complete all work and turn over a completed and standards compliant optical fiber cabling system to meet the City network installation system needs. The scheduled date for completion of optical fiber cabling and associated copper and wireless systems shall incorporate the activation dates for services need to activate all networked services including voice, data, special systems needed for a Certificate of Occupancy, the testing and operation of Building Monitoring Systems, and Electronic Safety and Security Systems.

B. Related Sections & References

1. Design, install and test data distribution systems per manufacturer's requirements and in accordance with NESC, NFPA 70 (National Electric Code), state codes, local codes, and requirements of authorities having jurisdiction.

    a) ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises

    b) ANSI/TIA/568-C.1, Commercial Building Telecommunications Cabling Standard

    c) ANSI/TIA/568-C.2, Copper Cabling Components Standard

    d) ANSI/TIA/568-C.3, Optical Fiber Cabling Components Standard

    e) ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

    f) TIA-590-A, Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant

    g) ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

    h) ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

    i) ANSI/TIA/758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard

    j) ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers

2. The Contractor is responsible to determine and adhere to the most recent edition of these standards when developing their responses and completing the project installation.

C. Quality Assurance

1. The City will inspect installation in progress. It is the responsibility of the Contractor to schedule regular and milestone inspection times with the City. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, buried, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected.

2. The Contractor will provide electronic test results and a 20 year manufacturer's warranty with a copy of the warranty to be submitted to the City at the completion of work.

D. Optical Fiber Backbone System Description

1. The main Entrance Facility (EF) and each Telecommunications Room (TR) shall house both voice and data backbone cabling and active equipment to support networking requirements. The EF in most cases shall be the main point of entry for outside services as well as main distribution point for all backbone cabling. Fiber optic backbone cable shall be employed between the EF and each TR for voice, data and special systems connectivity.

2. Optical fiber cabling systems vary depending upon system design, but a 144 fiber SMF cable is typical.

3. Optical Fibers in the backbone shall be terminated using a pigtailed assembly that have incorporated into those assemblies a LC connector that is fusion spliced to the backbone optical fibers, unless otherwise specified and approved by the City; housed in rack-mount fiber optic enclosures with cable supports.

4. All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors and fibers of each installed cable shall be verified useable prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced at the provider's expense in order to ensure 100% useable conductors in all installed cables.

370.2. Products

A. General

1. The materials and products specified herein reflect the minimum acceptable standards of fabrication and manufacture.

2. All materials and products supplied by the Contractor and specified herein are to be new, unused, of first quality and in original packaging or shipping containers.

3. Provide materials as specified or as approved equivalent by the City.

4. Match optical fiber glass for tie in to existing optical fibers.

5. The following manufacturer's warranted systems are approved unless otherwise specified:

a) AMP

b) Belden

c) Berk-Tek

d) CommScope

e) Corning

f) Ortronics

g) Siemons

A. Substitutions

1. Product substitutions shall be managed according to the following guidelines.

a) All substitutions shall be submitted to and approved by the City.

b) Acceptance of substitutions is at the City's discretion. The City reserves the right to determine suitability of the substitute product and reject any and all materials submitted for substitution. Submit requests for substitutions in writing to the City for approval within 10 days of contract award, or sooner if required to maintain the construction schedule.

c) Products rejected or otherwise judged unsatisfactory by the City will not be authorized for use in completing the work. Any unapproved products discovered as part of the installation will be removed and replaced with the City specified and approved products at the Contractor's expense.

d) Project Drawings may be based on equipment configuration of a particular manufacturer. If a substitution is approved, the Contractor shall make changes needed to accommodate the substitution at no expense to the City, including work under other divisions.

B. Outside Plant Fiber Optic Cable

1. General

a) Single mode fiber is the standard optical fiber media for backbone installations and optical fibers shall be low water-peak, laser optimized, suitable for CWDM use and complies with the ITU G.562.d. standard.

b) The cable types listed herein have been selected based on the typical environments and applications. It is the Contractor's responsibility to verify and submit an RFI on cables specified within that do not meet code or the environmental requirements of the project, environmental or code requirements of the installation before purchasing or providing.

c) When splicing into existing optical fibers the Contractor is to ensure the matching of optical fiber glass to the new and existing fibers and install the same glass type and manufacturer to prevent optical fiber mismatch.

2. Single Mode Optical Fiber Specification

a) Optical Characteristics – Single-mode fiber optic cable 8.3µm/125µm single-mode low water peak optical fibers.

b) Attenuation: 0.35dB/km @ 1310 nm; 0.25dB/km @ 1550 nm.

3. Multi-Mode Optical Fiber – When Specified by the City only.

a) Install Multi Mode optical fiber when approved and specified by the City.

b) Optical Characteristics – OM3 50µm/125µm laser optimized fibers, for new installations.

c) Optical Characteristics – OM1 62.5µm/125µm multimode optical fibers as specified for additions and modifications to existing of the same optical fiber.

4. Mechanical Construction – Armored fiber optic cable for direct-buried and conduit installation. Construction shall include: locatable central strength member or an IT approved equivalent, water swell-able yarn, buffer tubes/fibers, water swell-able tape, ripcord, polyethylene inner jacket, high tensile strength, corrugated steel tape armor (for direct buried applications), Polyethylene outer jacket, UV-stabilized jacket or equivalent.

a) Provide optical fiber color codes in compliance with Color TIA/EIA 527-7 and 14.

b) Cable shall be assembled to ensure that no more than 12 fiber strands occupy each buffer tube of like fiber strands.

c) Uni-tube Cable Construction: Fiber optic cables with 12 strands or less must include the following components:

i. Central Buffer Tube - Single loose buffer tube must provide sufficient clearance to allow for expansion without constraining the fiber. The fibers

must be loose or suspended within the tube. The fibers must not adhere to the inside of the buffer tube. Provide the number of fibers per cable as shown on the plans.

The loose buffer tube must have a coefficient of friction sufficiently low to allow free movement of the fibers. The material must be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.

Buffer tube filling compound must be a homogenous hydrocarbon based gel with anti-oxidant additives used to prevent water intrusion and migration. The filling compound must be non-toxic and dermatologically safe to exposed skin. It must be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound must be free from dirt and foreign matter and must be readily removable with conventional nontoxic solvents.

Water blocking tape may be used as an acceptable substitute for buffer tube filling compound.

Central buffer tube must be surrounded by peripheral strength members that will prevent stress on the fibers when the cable jacket is placed under strain.

ii. Core and Cable Flooding - The cable core interstices must contain a water blocking material, to prevent water ingress and migration. The water blocking material must be either a polyolefin based compound, which fills the cable core interstices, or an absorbent polymer, which fills voids and swells to block the ingress of water. The flooding compound or material must be homogeneous, non-hygroscopic, non-conductive, and non-nutritive to fungus. The compound or material must also be nontoxic, dermatologically safe and compatible with other cable components.

iii. Peripheral Strength Members - Tensile strength must be provided by high tensile strength aramid yarns, which must be stranded evenly around the central buffer tube and must not adhere to other cable components. The cable must have a short-term tensile strength of at least 300 lbf.

iv. Outerjacket - The jacket must be free of holes, splits, and blisters and must be medium or high density polyethylene, or medium density cross linked polyethylene with minimum nominal jacket thickness of 1 mm to 0.076 mm. Apply jacketing material directly over the peripheral strength members and water blocking materials. Jacketing material must not adhere to the aramid strength material. The polyethylene must contain carbon black to provide

ultraviolet light protection and must not promote the growth of fungus. Armored jackets shall not be used.

Mark the jacket or sheath with the manufacturer's name, the words "Optical Cable", the number of fibers, "SM", year of manufacture, and sequential measurement markings in feet. Make the marking in a contrasting color to the cable jacket.

d) Stranded Cable Construction: Fiber optic cables with more than 12 strands must consist of the following components:

i. Buffer tubes - Loose buffer tubes must provide sufficient clearance to allow for expansion without constraining the fiber. The fibers must be loose or suspended within the tubes. The fibers must not adhere to the inside of the buffer tube. Each buffer tube must not exceed a maximum of 12 fibers. Provide the number of fibers per cable as shown on the plans.

The loose buffer tubes must have a coefficient of friction sufficiently low to allow free movement of the fibers. The material must be tough and abrasion resistant to provide mechanical and environmental protection of the fibers, yet designed to permit safe intentional "scoring" and breakout, without damaging or degrading the internal fibers.
If used, buffer tube filling compound must be a homogenous hydrocarbon based gel with anti-oxidant additives used to prevent water intrusion and migration. The filling compound must be non-toxic and dermatologically safe to exposed skin. It must be chemically and mechanically compatible with all cable components, non-nutritive to fungus, non-hygroscopic and electrically non-conductive. The filling compound must be free from dirt and foreign matter and must be readily removable with conventional nontoxic solvents.

Water blocking tape may be used as an acceptable substitute for buffer tube filling compound.

Buffer tubes must be stranded around a central member by a method, such as reverse oscillation stranding process, which will prevent stress on the fibers when the cable jacket is placed under strain.

ii. Central Member - The central member which functions as an anti-buckling element must be a glass reinforced plastic rod with a similar expansion and contraction characteristic as the optical fibers and buffer tubes. To ensure the proper spacing between buffer tubes during stranding, a symmetrical linear overcoat of polyethylene may be applied to the central member to achieve the optimum diameter.

iii. Filler Rods - Fillers may be included in the cable to maintain the symmetry of the cable cross section. Filler rods must be solid medium or high-density

polyethylene. The diameter of filler rods must be the same as the outer diameter of the buffer tubes.

iv. Stranding - Completed buffer tubes must be stranded around the overcoated central member using stranding methods, lay lengths and positioning such that the cable meets mechanical, environmental and performance specifications. A polyester binding must be applied over the stranded buffer tubes to hold them in place. Binders must be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders must be non-hygroscopic, non-wicking, and dielectric with low shrinkage.

v. Core and cable flooding - The cable core interstices must contain a water blocking material, to prevent water ingress and migration. The water blocking material must be either a polyolefin based compound, which fills the cable core interstices, or an absorbent polymer, which fills voids and swells to block the ingress of water. The flooding compound or material must be homogeneous, non-hygroscopic, non-conductive, and non-nutritive to fungus. The compound or material must also be nontoxic, dermatologically safe and compatible with other cable components.

vi. Tensile strength member - Tensile strength must be provided by high tensile strength aramid yarns or fiberglass, which must be helically stranded evenly around the cable core and must not adhere to other cable components. The cable must have a short-term tensile strength of at least 600 lbf.

vii. Ripcord - The cable must contain at least one ripcord under the jacket for easy sheath removal.

viii. Outerjacket - The jacket must be free of holes, splits, and blisters and must be medium or high density polyethylene, or medium density cross linked polyethylene with minimum nominal jacket thickness of 1 mm +/- 0.076 mm. Jacketing material must be applied directly over the tensile strength members and water blocking materials and must not adhere to the aramid strength material. The polyethylene must contain carbon black to provide ultraviolet light protection and must not promote the growth of fungus. Armored jackets shall not be used.

Mark the jacket or sheath with the manufacturer's name, the words "Optical Cable", the number of fibers, "SM", year of manufacture, and sequential measurement markings in feet. Make the marking in a contrasting color to the cable jacket.

5. Approved Brands: Fiber optic cable shall be of the following brand and model or approved equal:

Table 370.1 – Approved Fiber Optic Cable

Uni-tube cable (12 or less strands)	Stranded cable (more than 12 strands)
Corning FREEDM series	Corning ALTOS EU4 series
Superior Essex Series 51	Superior Essex Series 11D
	Prysmian Draka ezPREP EDH series

C. Jumpers and Pigtails

1. Pigtails: Pigtails shall be of simplex (one fiber) construction, 900 μm PVC jacket. Minimum bend radius shall be 1.2 inches. Pigtail jackets shall be color coded to match the strand of connected cable. All pigtails shall be factory terminated and tested and at least six feet in length.

2. Jumpers: Jumpers may be of simplex or duplex design. Duplex jumpers shall be indicate polarity of connectors using unique colors or tags. All jumpers shall be at least three feet in length, sufficient to avoid stress and allow orderly routing. Provide strain relief for jumpers at both ends and elsewhere as needed. Minimum bend radius shall be at least 6 inches during installation and 3 inches following installation. The outer jacket shall be 2mm PVC and be yellow in color.

D. Fiber Optic Connectors

1. Provide for all new fiber optic installations with fusion spliced LC/APC pig tail connectors. The connectors shall be manufactured by the cabling system manufacturer and composed of the same optical fiber glass as used in the optical fiber cable specified by the project.

2. When adding to or modifying existing work coordinate connector type with the City.

3. The connector operating temperature range shall be -40°C to +70°C. Connection durability shall be less than a 0.2 dB change per 500 mating cycles per TIA-455-21A (FOTP-21).

4. Field terminations shall be limited to splicing of adjoining cable ends and/or cables to pigtails.

5. Multimode connectors, when specified shall be LC pigtailed connectors. They shall all be fusion spliced unless otherwise specified by the City.

6. Use the City approved color code (no exceptions) for coupler panels as follows:

a) 62.5um couplers – Beige

b) 50um couplers – Aqua

c) SM APC couplers – Green

E. Fiber Optic Enclosures

1. Wall mounted enclosures shall be approved by the City prior to system design and installation. The enclosure shall be equipped for a fusion spliced pigtail connector installation.

2. Provide wire management approved by the City to equipment and interconnection enclosures.

3. Rack Mount enclosures shall be approved by the City prior to system design and installation. The enclosure shall be equipped for pigtail connector splicing and installation.

4. Provide one 2RU wire manager, installed per rack at the top and one 2RU wire manager installed in the middle of the rack coordinated with the FDU installation to provide a crossover pathway for optical fiber jumpers.

5. Provide blank 2RU panel install below the top wire manager.

F. Optical Fiber Splice Closures

1. Enclose fiber optic field splices (other than within an FDU) in complete splice closures, with outer closure, splice organizer trays, brackets, clips, cable ties, seals and sealant as needed. The splice closure must be watertight, chemical and UV resistant, and rated for the environment in which they are to be installed.

2. The fiber optic splice closure must be suitable for a temperature range of 0°C to 40°C.

3. All splice closures shall be approved by the City prior to installation.

4. All closures shall be pressure tested. No encapsulate shall be used on fiber enclosures.

5. Provide Preformed Coyote Fiber Optic Splice Closures Kits or other approved by the City that are sized as required for the maximum fiber count within the splice case including distribution fibers.

6. Install only the splice enclosure manufacturer's specified splice trays. Splice only 12 fibers per splice tray (no exceptions, unless with written approval prior to installation

from the City project manager).

7. Splice trays shall be labeled with a permanent label on the front face of each splice tray indicating fiber count.

8. Support all closures with manufacturers approved brackets.

9. When placed in a junction box or vault, there must be sufficient space for routing of the fiber optic cables, without exceeding the minimum bending radius of any cable.

10. The closures must be designed to accommodate butt splicing.

11. The splice closure must meet the following requirements:

    a) Non-filled thermoplastic case

    b) Rodent proof, water proof, re-enterable and moisture proof

    c) Expandable from 4 cables per end to 8 cables by using adapter plates if necessary

    d) Cable entry ports must accommodate 0.25” to 1.0” diameter cables

    e) Multiple grounding straps

    f) Place no stress on finished splices within the splice trays

12. Include sufficient splice trays for minimum specified splice capacity in the splice closure. Individually mount and mechanically protect each splice in the splice tray.

13. Each closure must include at least 50’ of additional fiber length.

G. Innerduct

1. Aluminum threaded innerduct couplers shall be used to join two segments of corrugated innerduct together. Non-metallic couplers are not acceptable.

2. All innerduct shall have a measured pull tape rated for 400 lb. pulling tensile.

3. Each inner duct run shall be of the same manufacturer, model and size.

4. All runs with cables leaving the building shall be water and gas proof sealed using a method approved by the City.

5. Innerduct sealing plugs shall be used to seal used and unused innerducts. Use in conjunction with triplex duct sealing plugs.

H. Labels

1. Plastic cable labels shall be mechanically printed and shall be attached to all fiber optic cables using black UV rated cable ties or stainless steel cable ties within six inches of the splice closure and 6“ from all ducts and sleeves.

2. Provide electronically printed, waterproof, self-adhesive, laminated labels installable on the external surface of the outside panel of all FDU’s and closures.

370.3 Execution

A. Optical Fiber Backbone Installation

1. General

a) This Section describes the installation for the products and materials, as well as methods and the City Standards associated with the optical fiber backbone installation. These Specifications, along with the Drawings and other City supplied specifications shall be provided during the course of the installation.

b) The Contractor is instructed to coordinate his efforts with other trades who may be working within the same vicinity to avoid conflicts, lost time, cleaned environment for splicing and termination and potential injury. The City will assist in contractor coordination as requested or as required.

c) The Contractor shall install all materials plumb, square and in a workman-like manner.

d) The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.

e) The Contractor shall verify space requirements and locations with the project team and the City before starting cable installations and terminations proceed.

f) The Contractor shall verify the cable type and jacket rating required for use with the City before starting the fiber installation.

g) The Contractor shall verify existing cable fill in conduit, raceway or cable tray system prior to quote or bid and before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional conduit, raceway or cable tray where additional cables to be added will exceed the 40% cable fill.

h) The Contractor shall comply with all National, State of Oregon and local codes and City Policies, Procedures, Standards AND Design Guidelines during the course of installation.

i) Should any portion of these Specifications conflict with applicable Codes, the Contractor shall cease work on that particular aspect of the Project and notify the City immediately.

j) All equipment shall be installed in a neat and professional manner, arranged for convenient operation, testing and future maintenance.

k) All fiber cables shall be installed and terminated / fusion spliced by technicians trained and experienced in the installation and termination of fiber cables.

l) The Contractor shall employ certified system installation technicians and have at least 5 years experience in the installation of similar and equivalent systems.

m) The Contractor shall supply verification of experience, for this type of work, to the City for approval before performing any work.

2. Field Conditions

a) Fixed facility locations shown on the Drawings are based upon the latest design information available at the time this Specification was prepared.

b) The Contractor shall conduct field inspections to coordinate, verify and/or determine the actual as-built locations of conduits, manholes, handholes and all other special facilities that affect the installation, prior to commencing the installation in any area.

c) All EF/TR's and underground structures including utility tunnels, conduit and manhole systems, handholes and related fixtures shall be kept as clean as possible during installation. Labor required for any cleaning work shall be included in the quote or bid and provided by the Contractor.

3. Pre Cable Installation

a) Ensure the correct product(s) for the project have been received by the Contractor, are compliant to the project's product specification and have been approved for installation by the City. The Contractor should verify part numbers and footages on cable reel shipping labels, bills of lading, invoices, etc., shall be compared to the original order upon receipt and before installation.

b) The Contractor shall inspect fiber optic cable reels for damage upon receipt from the shipper and verify the receipt of the specified product before installation.

c) The contractor should verify the length of the cable both visually and by the results of the OTDR test to verify the project requirements prior to installation.

d) The Contractor will retain the manufacturer's test data and provide it, along with all other specified test documentation to the City at the completion of the Project.

e) All cable that does not meet the project or required City specification or approved by the City shall be removed and replaced at the contractor's expense.

4. Optical Fiber Installation Within Ductbanks & Innerducts

a) If field conditions prohibit the use of the designated duct, inner duct or multi-cell/sub duct, the Contractor is to contact the City for instructions prior to installation.

b) If existing multi-cell or innerduct duct specified is available, install one fiber cable in each sub-duct.

c) If cable is already installed within a duct without innerduct the Contractor is to contact the City for direction.

d) Install cables in accordance to the manufacturer's approved installation methods, procedures and instructions to ensure warranty compliance.

e) Install measured pull tapes with a minimum of 400 lb pulling tensile in conduits when installing cables or innerduct into occupied conduits.

5. Fiber Optic Cable Installation

a) Use mechanical aids to install cable.

b) Place tension measuring device or breakaway swivel between ends of cable grip and pull rope to ensure tension does not exceed 80
percent of recommended tension or 500 lbs., whichever is less.

c) Use cable grips with a ball bearing swivel for installing fiber optic cable to prevent cable from twisting during installation.

d) Adhere to cable manufacturer's specifications and recommended procedures, including:

- Installation
- Proper attachment to cable strength elements for pulling
- Bi-directional pulling
- Cable tensile limits and tension monitoring procedure
- Cable bending radius limits

e) Protect the loops from tangling or kinking. Do not exceed bending radius specifications.

f) Install fiber optic cable using cable-pulling lubricant as recommended by manufacturer.

g) Use a non-abrasive pull-tape. Station personnel at each junction box, vault, or cabinet to lubricate cable and prevent kinking or other damage.

h) Install pull line and locate wire, even if not shown.

i) Following installation of cable in conduit, seal all conduit entrances with conduit plug or duct-sealing compound to keep out moisture, foreign materials and rodents.

6. Installation of Optical Fiber within the EF/TR

a) Upon entering the EF/TR the backbone fiber optic cable shall be routed on cable tray to the designated rack location.

b) At least 25 feet of slack cable shall be included and stored as specified and approved by the City. A minimum of 2 times the diameter of the cable minimum bend radius shall be maintained. Cable slack in the TRs shall be contained and routed in the cable tray. Do not coil the cable to achieve the service loop. Store slack as approved by the City.

7. Splicing and Termination

a) The contractor is responsible to ensure that all outages associated with active cable and equipment is coordinated and approved by the City.

b) Fusion spice optical fibers in accordance to the approved fusion splicer, optical fiber and enclosure manufacturer's methods, procedures and instructions to ensure warranty compliance.

c) Perform all splice work in a controlled, weatherproof, dust-proof environment.

d) All optical fiber shall be neatly and efficiently dressed into splice tray management and the contractor is to ensure that splices are accessible without damage to the

optical fibers or splices.

e) The contractor is to ensure that all splice trays are labeled and optical fibers and trays properly secured.

f) The contractor shall test and call for splice inspections of all optical fiber splices before closing cable splice enclosures.

g) Individuals performing fiber optic terminations and splices must have a minimum of two years' experience terminating, splicing, and testing fiber optic cable, and possess either a Fiber Optics Installer or Fiber Optics Technician Certification recognized by the Electronics Technicians Association (ETA) or a Fiber Optics for ITS certificate from the International Municipal Signal Association (IMSA).

B. Fiber Optic Cable Testing

1. Scope of Work

a) Work covered by this Paragraph shall consist of furnishing labor, equipment and supplies unless otherwise specified, and in performing the following operations recognized as necessary for the successful testing and verification of the installation of the Fiber Optic cable plant described on the Drawings and required by these specifications.

b) Notify the City 48 hours in advance when work, technicians and equipment are prepared for acceptance tests and inspections. Coordinate a meeting with the City personnel to discuss the required testing procedures, required performance, test equipment, documentation, etc. to verify to the City a complete understanding of project requirements.

c) Provide technicians that are trained and certified in the use of the test equipment used for the testing operations associated with the specified work.

d) Maintain test equipment to manufacturers' requirements, and ensure that all equipment is calibrated according to the manufacturer's requirements. Provide a copy of the current calibration certificate associated with all test equipment associated with the contracted work.

2. Testing

a) Verify through visual inspection using an optical fiber test scope all fiber optic cable terminations, splices and connecting cables for defects and cleanness.

b) The fiber optic cables shall be tested utilizing a power meter and stabilized light source capable of testing at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode in one direction (TR to outlet) on each fiber, actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part #, installed fiber length, building span loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for single-mode and date tested. Testing required is 100%.

c) Place a printed copy and provide and electronic copy on a CD of the test results from the tester in a 3-ring binder, proceeded by a tabbed divider and label as "Backbone Fiber": To_____ From_____.

d) Span loss calculations are required on the final test sheet for loss at 850 nm and 1300 nm for multimode and 1310nm and 1550nm for Single-mode.

(D = Length x L = Fiber Loss) + (C x # connectors Loss) + (# Splices Loss)

e) Maximum Acceptable Connector Loss Values

Table 370.2 – Maximum Acceptable Connector Loss

Fiber Type	Test Wavelength	Mated Pair Connector Loss (each including fusion splice)
50/125 Multimode	850nm	0.5 dB
50/125 Multimode	1300nm	0.5 dB
62.5/125Multimode	850nm	0.5 dB
62.5/125Multimode	1300nm	0.5 dB
Single-mode	1310nm	0.5 dB
Single-mode	1550nm	0.5 dB

f) Acceptable Fiber Type Test Wavelength Fusion Splice Loss (each)

Table 370.3 – Acceptable Fiber Type Test Wavelength Fusion Splice Loss

Fiber Type	Test Wavelength	Splice Loss (each)
50/125 Multimode	850nm	0.10 dB
50/125 Multimode	1300nm	0.10 dB
62.5/125Multimode	850nm	0.10 dB
62.5/125Multimode	1300nm	0.10 dB
Single-mode	1310nm	0.10 dB
Single-mode	1550nm	0.25 dB

g) Testing requirements for Attenuation and Reflection

   i. Acceptable attenuation shall be calculated based upon on connector, type, number of splices and optical fiber length and shall comply with TIA/EIA 526. Attenuation shall not exceed the specified perimeters established by the manufacturer and the requirements of this section

   ii. Reflection test perimeter shall not exceed > - 40 db per connector or splice.

h) The total optical fiber segment performance shall not exceed the summation of all the manufacturers components specified performance parameters (Loss Budget) and/ or the combined loss values of components in Section 2.04 of this document.

i) Verify through bi-directional dual frequency power meter testing the attenuation and power loss of each point to point fiber optic strand and connectors. Test method (B) TIA/EIA 526 (7 and 14) is required.

j) Test all inter/intra building optical fiber segments using an OTDR with launch and receiving cables on each end during each test operation.

k) All optical fiber testing shall utilize the manufacturers specified and approved test jumpers and adapters.

l) Optical fiber cable that is left un-terminated at both ends shall be tested using a launch cable and bare fiber adapter.

m) Fiber optic cable that is left un-terminated at one end shall be tested at the connector end using an OTDR.

n) Submit electronic copy of test results within two calendar days of each test to the Engineer, including results of failed tests or re-tests for approval. Include the following information in test results submittals:

- Contract name and number
- Contractor name and address
- Testing technician name
- Date and time of test
- Dates of cable manufacture, installation, and testing
- Cable identification with traceability from factory to installation
- Fiber numbers and/or ports tested
- Locations of test origin and end points
- Termination and port identification
- Fiber segment length

- Test wavelength
- Test results
- One licensed copy of applicable OTDR reader program

o) If the test results are unsatisfactory, the fiber is unacceptable. Repair the unacceptable fiber at no additional cost to the City and then retest to demonstrate acceptability.

C. Labeling

1. Fiber Color Code approved for sequencing follows:

Table 370.4 – Fiber Color Code

Number	Color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua

D. Record Drawing Information

1. Contractor shall provide record drawing information to the City to accompany all test result information.

2. Record drawing information shall be in electronic format as a PDF/A. Indicate location of all outlets, distribution cable trays, junction boxes, FDU with configuration, optical fiber cable equipment rack layout with cable designators and counts and all additions and deletions pertaining to the backbone optical fiber cabling system.

3. Contractor shall provide one set of preliminary as-build information, splice diagrams and test results including all test result information 30 days prior to occupancy to ensure the scheduled installation and activation of the City equipment and services.

4. Failure of the contractor to provide the required record drawing information in a timely manner for the City to prepare cutover information may cause an installation delay for the project due to the contractors not meeting these requirements. The delivery of the record drawing documentation needs to be coordinated with the City as a project milestone.

5. The Contractor shall provide at substantial completion a list of all uncompleted work and a punch list of open items to the City Project Manager and prior to City scheduled activations.

6. If construction drawings are not utilized, contractor shall provide all telecommunications location information on an accurate and electronic formatted scaled floor plan preapproved by the City.

7. Partial as-builds shall be submitted as additional cabling is completed to meet installation schedules. The Contractor shall provide one set of preliminary as-build information, equipment layouts including elevations and test results to meet the schedule requirements of the City equipment installation and activation.

8. As final submission, provide a CD with 2 copies of the IBNS in Excel format one copy shall be locked and the second shall be in an open, searchable format. Provide floor plans with outlet locations and ID's in Auto Cad and Complete Test results (not just summary sheet) in LinkWare.

9. The final record drawing shall be submitted with all corrections made no later than 30 days after cabling installation is completed.

10. For general record drawing requirements see Subsection 120.6.

E. System Warranty

1. Contractor shall provide a 20-year extended manufacturer’s warranty in addition to the contractor’s warranty provided to the project. The warranty shall be titled to the City. The warranty shall begin at the system acceptance date and remain in effect for a period of 20 years from that date.

2. The umbrella warranty provided for the optical fiber backbone cabling system shall be issued by the manufacture of the cabling system. The contractor shall provide to the City any additional warranties from partners in addition to the cabling system warranty, i.e. cable manufacturer, contractor warranties. Acceptable manufacturer warrantees include:

    - AMP
    - Belden
    - CommScope/Systimax/Uniprise
    - Ortronics
    - Siemons

- Corning

a) All installed systems must conform to the manufacturer's official published specifications. Any exceptions agreed to by the contractor and the manufacturer shall be approved by the City. The contractor shall submit in writing and obtain approval from the City for all exceptions pertaining to the cabling system's warranty prior to the request being submitted to the manufacturer.

b) The warranty shall include a warranty of the applications published by the manufacturer at the time of the warranty application. The contractor is to provide to the City a list of these applications.

c) The contractor will provide the City with a copy of the warranty application at the time of submittal to the manufacturer.

d) Contractor shall perform all labeling requirements and provide testing documentation for verification and submittal to the manufacturer and the City. A copy of the warranty application and all documentation and test results shall be submitted simultaneously to the City and the manufacturer.

e) Contractor shall provide complete record drawing copies intra and inter building cable and infrastructure plans sent to the manufacture showing final locations of all FDU's and splice enclosures prior to submission of the warranty application. The contractor is to ensure that the warranty submittals match the submitted record drawing.

f) Contractor shall submit for the warranty all cable records to reflect moves, adds, and changes as-built.

g) The contractor shall include and schedule the City in all site surveys and inspections that relate to the warranty application or processes.

380. Fiber to the Premises

For design and construction standards applicable to the City of Hillsboro Fiber to the Premises system, refer to Standard Drawings 380-1 through 380-5.